## 2.22 Detection Threshold Conceptual Model Specification

The detection threshold of a radar is the minimum target-signal power for which the radar can detect a target, with a given probability of success, in the presence of the radar thermal noise and/or some external influence. Since the factors influencing target detection are generally noise-like (randomly occurring), the criterion for detection is usually described by some form of probability distribution with associated probabilities of detection ($P_d$) and false alarm ($P_{fa}$). Signal integration and signature fluctuations (described in Sections 2.25 and 2.4, respectively) are closely related to this functional element.

Thresholding can be modeled at levels ranging from a simple envelope detection using a signal-to-interference ratio (S/I) test to a comprehensive representation of a cell averaging constant false alarm rate (CFAR) system. In the simple S/I methodology, target detection occurs provided that S/I exceeds a pre-specified value (the threshold). In the next step up in complexity, the $P_d$ is calculated. In this case, detection can be based either on this probability exceeding a certain value, or on a pseudo-random draw.

The most complex modeling of threshold, not appropriate for all radars, simulates a cell averaging CFAR process that adjusts the detection threshold as a function of the environment while maintaining a constant false alarm rate. This process establishes range bins and doppler filters that are monitored for the presence of a target at a certain azimuth and elevation. Cell averaging CFAR ensures the false alarm rate will not be excessive, even though the radar is operating in a cluttered background or in the presence of some types of electronic countermeasures. The threshold for an individual CFAR cell is adjusted by sampling the energy in a selected number of cells adjacent to the target cell. The energy is averaged and multiplied by a factor which is a function of the $P_{fa}$ and the number of cells monitored.

In ALARM 3.0, the S/I is compared to a threshold to determine detection; CFAR is not modeled. The purpose of the threshold functional element in ALARM is to establish a S/I level at which target detection occurs and to use that threshold to make a detect/no-detect decision. This S/I detection threshold may be specified or it may be computed as a function of the desired probability of target detection, the desired tolerance for false alarms, and the desired signature fluctuation distribution assumed by the radar.

### 2.22.1 Functional Element Design Requirements

This section contains the design requirements necessary to implement the simulation of detection threshold in ALARM 3.0.

1. ALARM will determine target detection by comparing the computed signal-to-interference ratio to a threshold value.

2. ALARM will provide the capability for the user to input the detection threshold value to be used.

3. ALARM will provide the capability to compute the detection threshold based on user-selected $P_d$, $P_{fa}$, and assumed signature fluctuation distribution.

### 2.22.2 Functional Element Design Approach

This section describes the design elements that implement the detection threshold design requirements. A design element is an algorithm or feature that represents a specific component of the FE design. Design Element 22-1 supports Design Requirements 2 and 3, allowing a user to input a threshold value or have ALARM calculate one. Design Elements 22-2 and 22-3 address the ALARM calculation of a threshold value (Design Requirement 3). Design Elements 22-4 and 22-5 implement the actual detection decision of Design Requirement 1.

#### Design Element 22-1: User-Input Threshold Value

The user may input a threshold value T or input a flag instructing ALARM to calculate T based on additional user inputs.

#### Threshold Calculation Design Elements

The next two design elements are used when the user instructs the model to calculate the threshold value. The ALARM 3.0 calculation of a threshold value is based primarily on an earlier subroutine called THRESH, developed in 1985 by Jon Covala for Swerling, Manasse, and Smith [A.1-26]. The earlier routine was based on the detectability factor methodology given in Blake [A.1-25]. Blake defines the detectability factor to be the minimum value of S/I that produces detection; i.e., the threshold is the detectability factor for a single pulse.

### Design Element 22-2: Detectability Factor with No Fluctuations

In equations 2.29-2.33 of [A.1-25], the detectability factor $\bar{D}_o$(N), for a nonfluctuating target, is defined as follows:

$$\bar{D}_o(N) = \frac{X_o}{4H_N}\left(1 + \sqrt{1 + \frac{16H_N}{\zeta X_o}}\right) \qquad (2.22\text{-}1)$$

where $X_o$ is computed by

$$X_o = (g_{fa} + g_d)^2 \qquad (2.22\text{-}2)$$

with

$$g_{fa} = 2.36\sqrt{(-\log P_{fa})} - 1.02 \qquad (2.22\text{-}3)$$

and

$$g_d = \frac{1.231t}{\sqrt{1 - t^2}} \qquad (2.22\text{-}4)$$

| | | | |
|---|---|---|---|
| where | $P_{fa}$ | = | probability of false alarm |
| | t | = | 0.9 ($2P_d$ - 1) |
| | $P_d$ | = | probability of detection |
| | $H_N$ | = | equivalent number of pulses integrated |
| | $\zeta$ | = | asymptotic efficiency of the envelope detector |

Since the threshold calculations use only a single pulse, N = 1, and hence $H_N$ = 1. [NOTE TO DEVELOPER: Does $H_N$ = 1 only for constant signal power and ideal or uniform weight integrators? See Blake, table 2.2.]

The asymptotic efficiency $\zeta$ is defined as follows (table 2.1, [A.1-25]):

$$\zeta = \begin{cases} 1.000 \text{ for square-law detector} \\ 0.915 \text{ for linear detector} \end{cases} \qquad (2.22\text{-}5)$$

### Design Element 22-3: Inclusion of Fluctuation Loss

To calculate the detection threshold, T, ALARM adjusts the detectability factor to account for a fluctuating target. The following equation is based on the discussion on page 72 of [A.1-25].

$$T = D_0(1) = \overline{D}_0(1) + L_f(1) \tag{2.22-6}$$

where $D_0(1)$ = detectability factor (including fluctuation) for 1 pulse (dB)
$\overline{D}_0(1)$ = detectability factor (not including fluctuations) for 1 pulse (dB)
$L_f(1)$ = fluctuation loss for 1 pulse (dB)

The calculation of loss due to target signature fluctuation is described in Section 2.4. Since just one signature fluctuation distribution is allowed in the threshold computation, only the first three design elements in Section 2.4.2 apply here, not the last one.

### Design Element 22-4: Detection Decision for Flight Path Mode

ALARM allows up to three possible outcomes of the detection decision: "detect", "no detect", or "coherently jammed". For pulsed (MTI) radars with deception jamming present, then either the true target signal or the false target signal is selected as the "presumed" target signal to be processed by ALARM (see Section 2.10), and three outcomes are possible:

$$\begin{aligned} &\text{If } S = S_T \text{ and } \frac{S}{I} \geq T, \text{ then the target is detected} \\ &\text{If } S = S_F \text{ and } \frac{S}{I} \geq T, \text{ then the radar is coherently jammed} \\ &\text{If } \frac{S}{I} < T, \text{ then no detection occurs} \end{aligned} \tag{2.22-7}$$

where S = presumed target signal
$S_T$ = true target signal
$S_F$ = false target signal
I = interference signal
T = threshold

If no deception jammer is present, then S always equals $S_T$, so only two outcomes are possible.

For pulse doppler radars, algorithm (2.22-7) is performed for each PRF, and the overall detection status is determined as follows:

> If the true target is detected by at least one PRF,
> then the target is detected.
>
> If the true target is not detected by any PRF, and
> the false target is detected for at least one PRF,
> then the radar is coherently jammed. (2.22-8)
>
> If neither the true target nor the false target is
> detected by any PRF, then the result is no detection.

[NOTE TO DEVELOPER: Don't you want to require "detection" by several PRFs (in order to establish target range) before detection is declared? Of course, this would raise questions about how to handle deceptive jamming.]

### Design Element 22-5: Detection Decision for Contour Mode

For the target mode that produces data for a contour plot, the detection decision is made during post-processing. If the standard post-processor BINPRO is used, detection is determined as follows:

$$\text{If } \frac{S}{I} \geq T\text{, then target is detected}$$

$$\text{If } \frac{S}{I} < T\text{, then target is not detected} \tag{2.22-9}$$

where

| | | | |
|---|---|---|---|
| where | S | = | presumed target signal (either true target or false target) [NOTE TO DEVELOPER: Is this what you really want?] |
| | I | = | interference signal |
| | T | = | threshold value |

For pulse doppler radars, S/I is computed for each PRF and detection is declared if the threshold is passed for at least one PRF:

$$\begin{aligned} &\text{If } \frac{S}{I} \geq T \text{ for any PRF, then target is detected} \\ &\text{If } \frac{S}{I} < T \text{ for all PRFs, then target is not detected} \end{aligned} \qquad (2.22\text{-}10)$$

where S = presumed target signal (either true target or false target) [NOTE TO DEVELOPER: Is this what you really want?]
I = interference signal
T = threshold value

[NOTE TO DEVELOPER: Don't you want to require "detection" by several PRFs (in order to establish target range) before detection is declared? Of course, this would raise questions about how to handle deceptive jamming.]

### 2.22.3 Functional Element Software Design

This section contains the software design necessary to implement the functional element requirements described in Section 2.22.1 and the design approach described in Section 2.22.2. It is organized as follows: the first part describes the subroutine hierarchy and gives descriptions of the relevant subroutines; the next part contains logical flow charts and describes important operations represented by each block in the charts; the last part contains a description of all input and output data for the functional element as a whole and for each subroutine that implements the Detection Threshold FE.

#### Detection Threshold Subroutine Design

The FORTRAN call tree implemented for the Detection Threshold Functional Element in the ALARM 3.0 code is shown in figure 2.22-1. The diagram depicts the structure of the entire model for this functional element, from ALARM (the Main program) through the least significant subroutine implementing integration. Subroutines which directly implement the functional element appear as shaded blocks. A portion of this FE is implemented outside the model itself in a post-processing program. Each of these modules is described briefly in table 2.22-1.

Table 2.22-1 Subroutine Descriptions

| MODULE NAME | DESCRIPTION |
|---|---|
| OUTPUT | Writes output data to binary and ASCII files |
| PULDOP | Cycles through flight path or plot matrix points, controls calculation of factors in radar range equation for pulse doppler radar, decides Detect/No detect in flight path mode |
| PULSED | Cycles through flight path or plot matrix points, controls calculation of factors in radar range equation for pulsed radar, decides Detect/No detect in flight path mode. |
| RDRERR | Checks for legality of user input data for the radar parameters |
| RDRINP | Reads user inputs for radar parameters |
| RDRINT | Performs initial processing on user inputs for radar parameters |
| RDRPRT | Prints user inputs for radar parameters |
| THRESH | Calculates detection threshold of the radar (or integration gain and fluctuation loss) given probability of detection and false alarm |
| BINPRO | (Auxiliary Program) Post processes ALARM output data, decides Detect/No detect for contour mode |

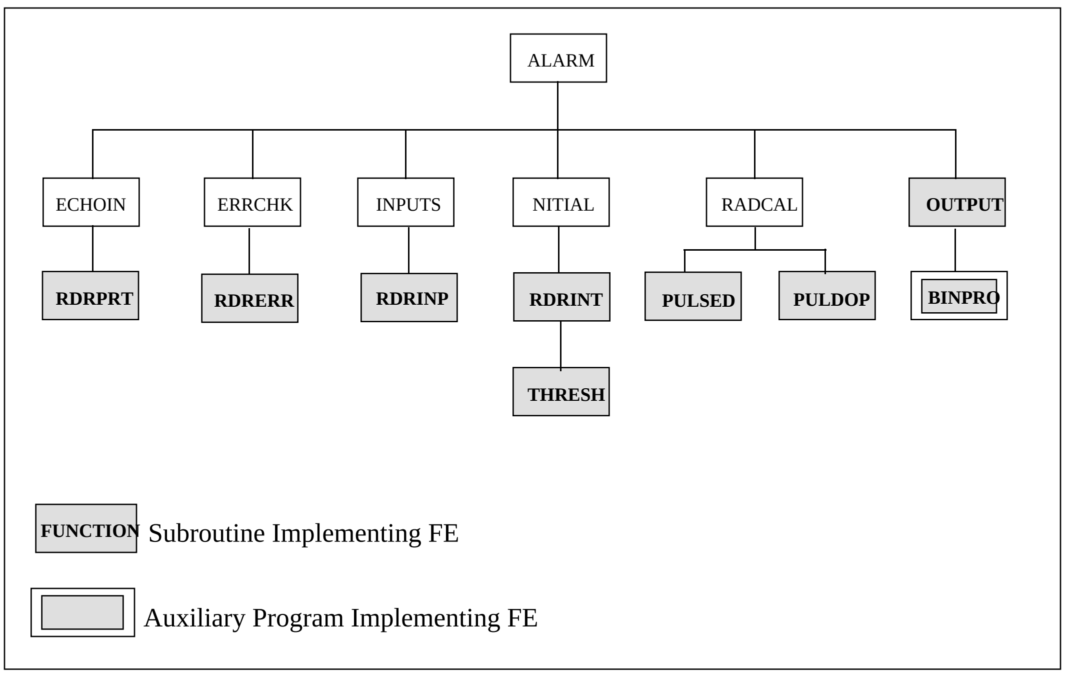


Figure 2.22-1 Call Hierarchy for Detection Threshold

## Logical Flow

Figure 2.22-2 shows the top-level logical flow of the detection threshold implementation. The numbered blocks are described below.

**Blocks 1-2:** ALARM, the main program, calls subroutine NITIAL which calls RDRINT to initialize radar parameters. RDRINT controls determination of the threshold value as shown in figure 2.22-3. The remainder of the Detection Threshold FE is controlled by subroutine PULSED for pulsed (MTI) radars or by subroutine PULDOP for pulse doppler radars. (ALARM calls RADCAL which calls either PULSED or PULDOP).

Blocks 3-18 are performed by both PULSED and PULDOP. In PULDOP, operations indicated by a single box are usually performed for each PRF.

**Block 3:** Two target position modes are available for both types of radars. Since the contour plot mode typically consists of a much larger set of target position points than the flight path mode, the radar processing algorithms are performed in different orders for the two modes to avoid unnecessary calculations and shorten model run time.

Blocks 4-10 or 11-20 are actually performed for each target position, but these loops are omitted since the FE applies only to each position. Target position geometry calculations also are omitted since they are not part of this FE.

Blocks 4-10 describe the process for flight path mode.

**Block 4:** In flight path mode, flags are initialized to indicate that the target is not detected and the radar is not misled (by deceptive jamming) into "detecting" a false target (PULDOP does this for each PRF).

**Block 5:** Target body signal, target rotor signal (if any), clutter signal, system noise signal, and all jammer signals are computed. (PULDOP does this for each PRF.)

**Block 6:** If a deception jammer is present, the routine determines whether or not the false target signal is sufficiently stronger than the true target signal to mislead the radar. If so, the false target signal replaces the true target signal in all the following computations. (PULDOP performs Blocks 6-9 in a loop on PRF.)

**Blocks 7-9:** The quantities calculated in Blocks 5 and 6 are used to compute the total S/I and compare it to the threshold value to determine target detection status according to algorithm

(2.22-7). PULSED sets the output variable MSKOUT to "Detectd" if the true target signal is detected, "Coh-Jam" if a false target signal is detected, or "Undetec" if no detection is made.

For each PRF, PULDOP increments NDETEC if the true target signal is detected or increments NCOJAM if a false target signal is detected. After completing the loop on PRF, PULDOP examines the values of NDETEC and NCOJAM to set the output variable MSKOUT according to algorithm (2.22-8).

**Block 10:** For flight path mode, this FE is completely processed within ALARM proper. After processing this FE for one flight path point, PULSED or PULDOP continues to the next point. When all points have been processed, program control returns to RADCAL and then to the main program.

Blocks 11-20 describe the process for contour plot mode.

**Block 11:** Signals for target body, target rotor (if any), and system noise are computed and combined to produce the signal-to-noise ratio (PULDOP does this for each PRF.)

**Block 12:** If the signal-to-noise ratio is less than the threshold, there is no need to calculate clutter or noise jamming signals because these values would only decrease the signal-to-noise ratio; i.e., no detection of the target is possible. However, if a deception jammer is part of the scenario, a false target could be detected. Thus, processing continues in Block 13 if and only if there is a possibility of detecting either the true target or a false target; otherwise, program control goes to Block 18. For pulse doppler radars, processing continues if there is a possibility of at least one PRF detecting either the true target or a false target.

**Block 13:** PULSED or PULDOP calls JAMMER to compute all jamming signals. For pulse doppler radars, this is done for all PRFs.

**Block 14:** The signal from the false target (if any) is compared to the true target signal to determine which will be used as the "presumed target" for determining detection (see Section 2.10). For pulse doppler radars, this is done for each PRF.

**Block 15:** Noise jamming signals are added to the system noise to obtain interference, and the presumed target signal-to-interference ratio is calculated. For pulse doppler radars, this is done for each PRF.

**Blocks 16-18:** If the signal-to-interference ratio is greater than or equal to the threshold (for any PRF, in PULDOP), then the clutter signal is computed and added to the interference value in order to calculate a new signal-to-interference ratio. If no detection is possible because the ratio without clutter is already less than the threshold (for all PRFs), then clutter signal is not calculated and the S/I is unchanged. In either case, the maximum signal-to-interference ratio among all PRFs is calculated for pulse doppler radars. The single or maximum S/I for this target position is stored for output and post-processing. This is the end of processing this FE for one target position within the ALARM model proper. After processing all target positions, the model completes execution by returning control to RADCAL and then to the main program (ALARM) to produce output for post-processing. The remaining blocks are performed using this output.

**Blocks 19-20:** In contour mode, the actual detection decision is performed during post-processing. PULSED or PULDOP passes the S/I results to subroutine OUTPUT. Subroutine OUTPUT writes S/I and threshold values to a binary file for processing by BINPRO. The program BINPRO decides whether or not a particular target position point is to be plotted by comparing the signal-to-noise ratio to the threshold as shown in algorithm (2.22-9) for pulsed radars, (2.22-10) for pulse doppler radars.

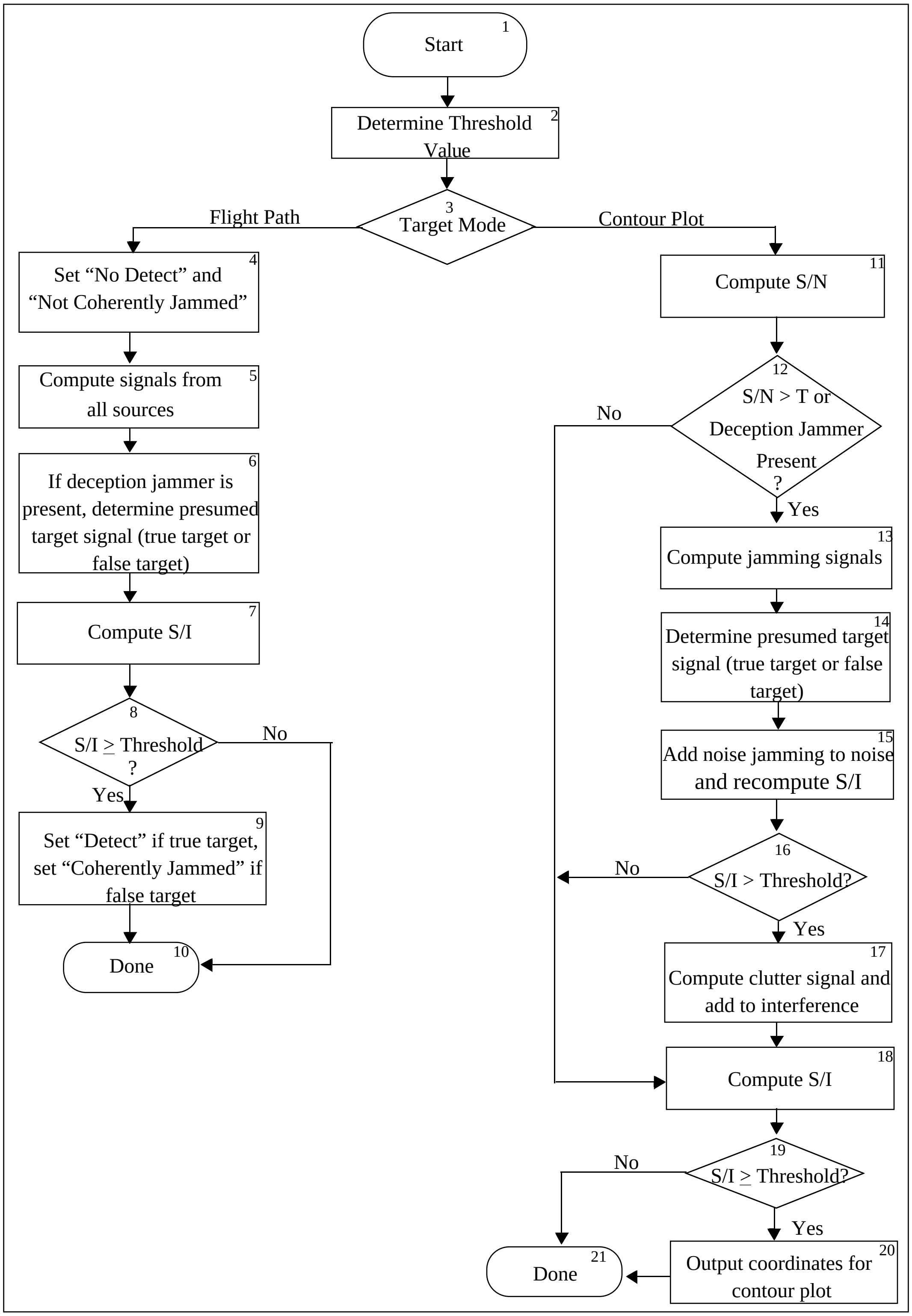


Figure 2.22-2 Detection Threshold Logical Flow

### Logical Flow for Threshold Value Calculation

Figure 2.22-3 shows the logical flow for the calculation of the threshold value; it is an expansion of Block 2 in the previous figure. Subroutine names appear in parentheses at the bottom of each process block. The numbered blocks are described below.

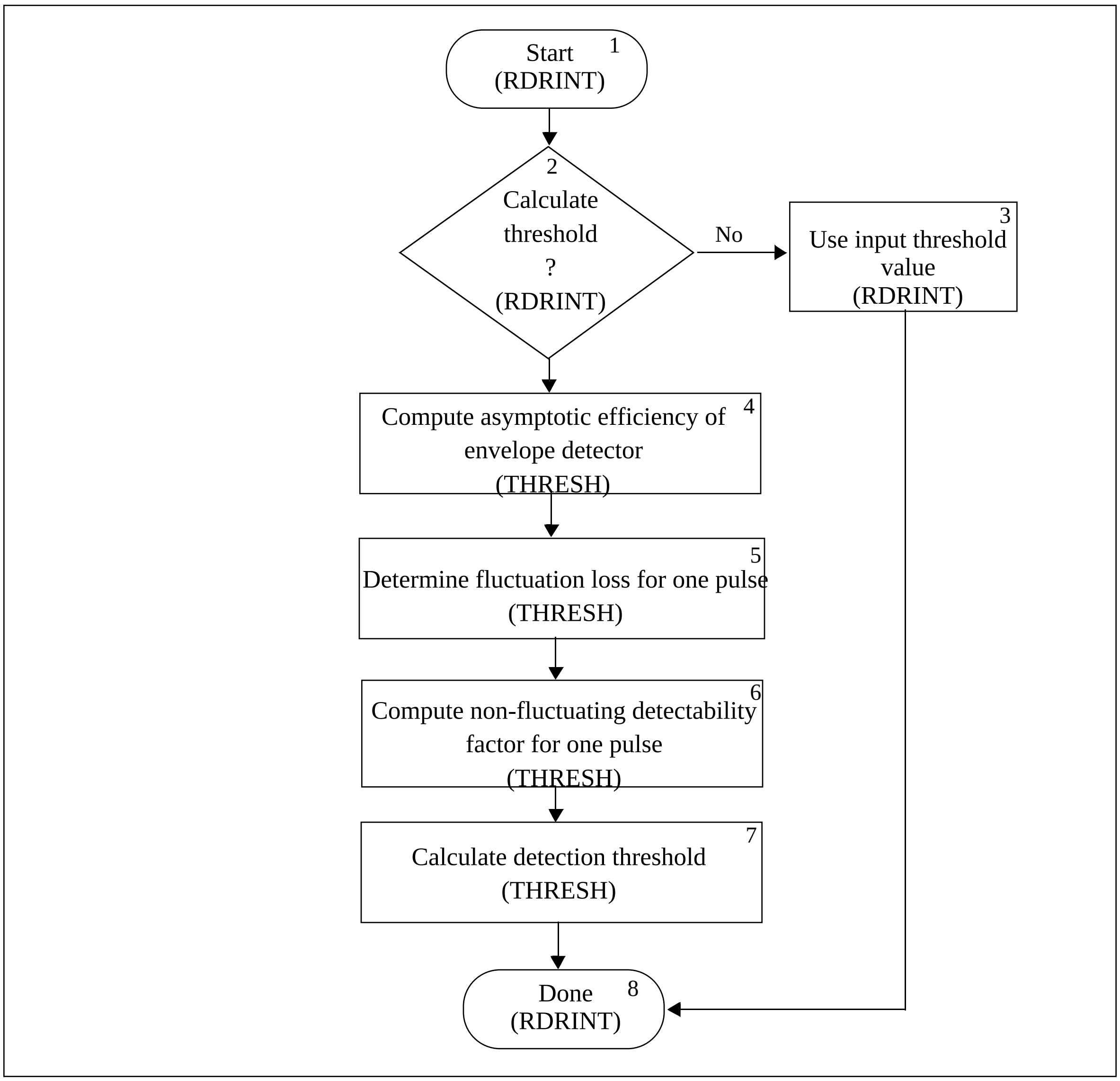


Figure 2.22-3 Logical Flow for Calculation of Threshold Value

**Blocks 1-3:** The radar parameter initialization routine RDRINT controls the calculation of the detection threshold. As indicated by Design Element 22-1, the user can input the actual threshold value to be used for detection decisions in variable THOLDB. If that is done, the initialization process merely consists of setting the threshold equal to that input value (Block 3). However, the user may input THOLDB = -380 as a flag indicating the threshold should be calculated. The calculation is done during run initialization as shown in Blocks 4-8.

Note: Blocks 4-8 in this flow chart do not depict the exact flow of logic in subroutine THRESH because the calculations for Signature Fluctuations and Signal Integration are inextricably intertwined with the detection threshold calculations. Figure 2.22-3 is an attempt to display the major logical steps for detection threshold calculation without repeating information contained in other sections.

**Block 4:** Before any other calculations, equation (2.22-5) is used to compute ETA, the asymptotic efficiency of the envelope detector. Note that ETA is the FORTRAN variable in THRESH that corresponds to $\zeta$ in Section 2.22.2 and [A.1-25].

**Block 5:** The calculation of fluctuation loss is described in Section 2.4. The applicable functional flow is shown in Blocks 3-6 of figure 2.4-2. Note that only one fluctuations distribution is used in determining the threshold and it is independent of the distributions used to describe the actual target fluctuations.

**Block 6:** The nonfluctuating target detectability factor ($\bar{D}_o$) is calculated for one pulse (ABSD1) using equation (2.22-1). This is then converted to dB (DBSNR1).

**Block 7:** Fluctuation loss is converted to dB and equation (2.22-6) is used to calculate the detection threshold (CONTOR) from the detectability factor and fluctuation loss values.

**Block 8:** The value of the detection threshold is passed back to RDRINT, stored in the common block RADPAR, and used in PULSED or PULDOP for detection decisions as shown in figure 2.22-2.

## Detection Threshold Inputs and Outputs

The possible outputs of this functional element are shown in table 2.22-2. User inputs which affect detection threshold are given in table 2.22-3.

Table 2.22-2 Detection Threshold Outputs

| VARIABLE NAME | DESCRIPTION |
|---|---|
| CONTOR | Detection Threshold (dB) |
| MSKOUT(IPT)(7:13) | Detection status for flight path mode. Possible values are<br>"Detectd"<br>"Undetec"<br>"Coh-Jam" |
| CRANGE * RNGFAC,<br>DRANGE * RNGFAC | Coordinates of a target position are output for plotting if and only if the target is detected at that position. NOTE: These are output by the post processor program BINPRO, not by the ALARM model proper. |

Table 2.22-3 User Inputs for Detection Threshold

| DATABLOCK NAME | VARIABLE NAME | DESCRIPTION |
|---|---|---|
| DATARADR | THOLDB | Threshold value specified by user. If THOLDB=-380, ALARM uses the remaining input variables to calculate the threshold. |
| DATARADR | ISQLW | 0 = linear detector, 1 = square-law detector |
| DATARADR | NPULSE | Number of pulses integrated |
| DATARADR | PSUBFA | Probability of false alarm |
| DATARADR | PSUBD | Probability of detection |
| DATARADR | IFLMOD | Target fluctuation model assumed by radar:<br>0 = non-fluctuating 4 = Swerling 4<br>1 = Swerling 1 5 = Chi-square<br>2 = Swerling 2 6 = Weinstock<br>3 = Swerling 3 7 = Log-normal |
| DATARADR | CHINDR | Number of degrees of freedom for chi-square and Weinstock target models |
| DATARADR | CORELR | Number of correlated blocks for chi-square target model |
| DATARADR | SIGDBR | Sigma parameter of a log-normal target model |

Tables 2.22-4 through 2.22-10 describe the inputs and outputs of all subroutines and auxiliary programs that implement the Detection Threshold FE. Inputs and outputs directly related to this FE are printed in bold. The table for OUTPUT is different from the others because almost all variables are both inputs and outputs. The outputs from OUTPUT are written to files rather than passed to another routine.

Table 2.22-4 Subroutine OUTPUT Inputs and Outputs

| SUBROUTINE: OUTPUT | | | | |
|---|---|---|---|---|
| NAME | TYPE | INPUT | OUTPUT | DESCRIPTION |
| ALLINF | Common DATCOM | Y | Y | Array of results for flight path mode. Specific descriptions for each index are given below. |
| ALLINF (1,I) | Common DATCOM | | Y | Target azimuth (deg) (see AZDOUT) |
| ALLINF (2,I) | Common DATCOM | | Y | Target elevation (deg) (see ELDOUT) |
| ALLINF (3,I) | Common DATCOM | | Y | Target range (km) (see RNGOUT) |
| ALLINF (4,I) | Common DATCOM | | Y | Target speed (m/sec) (see VTARIN) |
| ALLINF (5,I) | Common DATCOM | | Y | Target RCS (sqm) (see RCSOUT) |
| ALLINF (6,I) | Common DATCOM | | Y | Total target signal power (dBm) (see TAROUT) |
| ALLINF (7,I) | Common DATCOM | | Y | Clutter signal power (dBm) (see CLTOUT) |
| ALLINF (8,I) | Common DATCOM | | Y | On-board jammer signal power (dBm) (see SOBJDB) |
| ALLINF (9,I) | Common DATCOM | | Y | Total standoff jammer signal power (dBm) (see SSOJDB) |
| ALLINF (10,I) | Common DATCOM | | Y | S/I ratio (dB) (see STIOUT) |
| ALLINF (11,I) | Common DATCOM | | Y | The bank (roll) angle of the target (deg) (see BNKDEG) |
| ALLINF (12,I) | Common DATCOM | | Y | Target heading (deg) (see HEDDEG) |
| ALLINF (13,I) | Common DATCOM | | Y | Target latitude (rad) (see TARGLA) |
| ALLINF (14,I) | Common DATCOM | | Y | Target longitude (rad) (see TARGLO) |
| ALLINF (15,I) | Common DATCOM | | Y | Target altitude above MSL or AGL (m) (see ZTARIN) |
| ALLINF (16,I) | Common DATCOM | Y | Y | Noise signal (dBm) |
| ALLINF (17,I) | Common DATCOM | Y | Y | Target signal atmospheric attenuation (dB) |
| ALLINF (18,I) | Common DATCOM | Y | Y | Target rotor signal (dBm) |
| ALLINF (19,I) | Common DATCOM | Y | Y | Interference signal (dBm) |
| ALLINF (20,I) | Common DATCOM | Y | Y | True target signal (dBm) |
| ALLINF (21,I) | Common DATCOM | Y | Y | False target signal (dBm) |

Table 2.22-4 Subroutine OUTPUT Inputs and Outputs

| SUBROUTINE: OUTPUT | | | | |
|---|---|---|---|---|
| **NAME** | **TYPE** | **INPUT** | **OUTPUT** | **DESCRIPTION** |
| ALLINF (22,I) | Common DATCOM | Y | Y | Target signal propagation pattern (dB) |
| ALLINF (23,I) | Common DATCOM | Y | Y | Atmospheric attenuation of OBJ signal (dB) |
| ALLINF (24,I) | Common DATCOM | Y | Y | On-board jamming signal pattern propagation factor (dB) |
| ALLINF (25,I) | Common DATCOM | Y | Y | Atmospheric attenuation of SOJ-1 signal (dB) |
| ALLINF (26,I) | Common DATCOM | Y | Y | Atmospheric attenuation of SOJ-2 signal (dB) |
| ALLINF (27,I) | Common DATCOM | Y | Y | Atmospheric attenuation of SOJ-3 signal (dB) |
| ALLINF (28,I) | Common DATCOM | Y | Y | Atmospheric attenuation of SOJ-4 signal (dB) |
| ALLINF (29,I) | Common DATCOM | Y | Y | Atmospheric attenuation of SOJ-5 signal (dB) |
| ALLINF (30,I) | Common DATCOM | Y | Y | SOJ-1 signal pattern propagation factor (dB) |
| ALLINF (31,I) | Common DATCOM | Y | Y | SOJ-2 signal pattern propagation factor (dB) |
| ALLINF (32,I) | Common DATCOM | Y | Y | SOJ-3 signal pattern propagation factor (dB) |
| ALLINF (33,I) | Common DATCOM | Y | Y | SOJ-4 signal pattern propagation factor (dB) |
| ALLINF (34,I) | Common DATCOM | Y | Y | SOJ-5 signal pattern propagation factor (dB) |
| ALLINF (35,I) | Common DATCOM | Y | Y | Ground range (km) |
| ALLINF (36,I) | Common DATCOM | Y | Y | Detection threshold (dB) |
| ALLINF (37,I) | Common DATCOM | Y | Y | Integration gain (dB) |
| ALLINF (38,I) | Common DATCOM | Y | Y | Noise signal (dBm) |
| ALLINF (39,I) | Common DATCOM | Y | Y | Target body signal (dBm) |
| ALLINF (40,I) | Common DATCOM | Y | Y | Computed $P_d$ |
| ALLINF (41,I) | Common DATCOM | Y | Y | Doppler circular scan rate (Hz) |
| AZDOUT | Common OUTCOM | Y | Y | Flight path mode - Target azimuth (deg) |
| BNKDEG | Common TARDAT | Y | | Bank (roll) angle of the target at the target flight path point (deg) |
| CLTOUT | Common OUTCOM | Y | Y | Flight path mode - Clutter signal (dBm) |

Table 2.22-4 Subroutine OUTPUT Inputs and Outputs

| SUBROUTINE: OUTPUT | | | | |
|---|---|---|---|---|
| **NAME** | **TYPE** | **INPUT** | **OUTPUT** | **DESCRIPTION** |
| **CONTOR** | Common RADPAR | Y | Y | Detection threshold (dB) |
| DESCRP | Local Variable | | Y | Array of descriptions of values in ALLINF |
| DFINAM | Common DATFIL | Y | | Output file name for flight path mode |
| DXYPLT | Common PLTCOM | Y | Y | X and Y increment for plot (m) |
| ELDOUT | Common OUTCOM | Y | Y | Flight path mode - Target elevation (deg) |
| FMFEED | Common PRINTR | Y | Y | Form feed character |
| HEDDEG | Common TARDAT | Y | | Heading angle of the target measured from true north at the target flight path point (deg) |
| IAGLCN | Common PLTCOM | Y | Y | Target Altitude flag:<br>1 = m above ground level<br>0 = m above MSL |
| IDATAF | Common TARDAT | Y | | Output flag:<br>1 = output data to a file for additional post processing<br>0 = do not output data to a file |
| ISBLOC | Common DBLOCK | Y | | Indicates whether or not the data block was supplied and if the data was complete |
| **MSKOUT** | Common OUTALP | Y | Y | Flight path mode - Array of masking and detection status indicators |
| NTPTS | Common TARDAT | Y | Y | Number of target flight path points |
| NUMXY | Common PLTCOM | Y | Y | Number of points in each row and column of contour plot matrix |
| PFINAM | Common PLTFIL | Y | | Output file name for contour mode |
| PLTLAB | Common TITLES | Y | Y | Plot label |
| RCSOUT | Common OUTCOM | Y | Y | Flight path mode - Aircraft radar cross section ($m^2$) |
| RNGOUT | Common OUTCOM | Y | Y | Flight path mode - Target range (km) |
| RNGPLT | Common PLTCOM | Y | Y | Maximum one-sided plot range (m) |
| SIGTOI | Common PLTCOM | | Y | Results for point (I,J) in contour plot mode. Specific descriptions follow |
| **SIGTOI (I,J,1)** | Common PLTCOM | Y | Y | Contour plot mode - Presumed S/I |
| SIGTOI (I,J,2) | Common PLTCOM | Y | Y | Contour plot mode - Terrain height (m above MSL) |
| SIGTOI (I,J,3) | Common PLTCOM | Y | Y | Contour plot mode - Computed $P_d$ |

Table 2.22-4 Subroutine OUTPUT Inputs and Outputs

| SUBROUTINE: OUTPUT | | | | |
|---|---|---|---|---|
| **NAME** | **TYPE** | **INPUT** | **OUTPUT** | **DESCRIPTION** |
| SOBJDB | Common OUTCOM | Y | Y | Flight path mode - On-board jammer signal (dBm) associated with the pulse repetition frequency |
| SSOJDB | Common OUTCOM | Y | Y | Flight path mode - Standoff jammer signal (dBm) |
| STIOUT | Common OUTCOM | Y | Y | Flight path mode - Presumed S/I (dB) |
| TARGLA | Common TARDAT | Y | | Latitude of the target flight path point (rad) |
| TARGLO | Common TARDAT | Y | | Longitude of the target flight path point (rad) |
| TAROUT | Common OUTCOM | Y | Y | Flight path mode - Target signal (dBm) |
| VTARIN | Common TARDAT | Y | Y | Flight path mode - Target speed (m/sec) |
| VTPLOT | Common PLTCOM | Y | Y | Contour plot mode - Target speed (m/sec) |
| ZTARIN | Common TARDAT | Y | | Flight path mode - Target altitude above MSL or AGL (m) |
| ZTPLOT | Common PLTCOM | Y | Y | Contour plot mode - Target altitude (m) |

Table 2.22-5 Subroutine PULDOP Inputs and Outputs

| SUBROUTINE: PULDOP | | | | | |
|---|---|---|---|---|---|
| **INPUTS** | | | **OUTPUTS** | | |
| **NAME** | **TYPE** | **DESCRIPTION** | **NAME** | **TYPE** | **DESCRIPTION** |
| ATTDEG | Common TARDAT | Attitude (climb) angle of the target flight path point (deg) | ALLINF | Common DATCOM | Array of results for each point I in flight path mode |
| BNKDEG | Common TARDAT | Bank (roll) angle of the target at the target flight path point (deg) | ALLINF (18,I) | Common DATCOM | Target rotor signal (dBm) |
| **CONTOR** | Common RADPAR | One-pulse S/I ratio required for target detection; i.e., threshold (dB) | ALLINF (19,I) | Common DATCOM | Interference signal (dBm) |
| COPHIS | Common SITLAM | Cosine of radar site latitude | ALLINF (20,I) | Common DATCOM | True target signal (dBm) |
| DBJTOS | Common JAMCOM | J/S ratio necessary for the jammer to be effective (dB) | ALLINF (21,I) | Common DATCOM | False target signal (dBm) |
| DEGRAD | Common CONSTR | Factor to change degrees to radians | ALLINF (35,I) | Common DATCOM | Ground range (km) |
| DOPCSR | Common GEOMRT | Sum of the conical scan rate and doppler frequency shift of the target (Hz) | ALLINF (36,I) | Common DATCOM | Detection threshold (dB) |

Table 2.22-5 Subroutine PULDOP Inputs and Outputs

| **SUBROUTINE: PULDOP** | | | | | |
|---|---|---|---|---|---|
| **INPUTS** | | | **OUTPUTS** | | |
| **NAME** | **TYPE** | **DESCRIPTION** | **NAME** | **TYPE** | **DESCRIPTION** |
| DXYLT | Common PLTCOM | X and Y increment in contour plot | ALLINF (37, I) | Common DATCOM | Integration gain (dB) |
| EPSLNR | Common GEOMRT | Radar antenna elevation angle (rad) | ALLINF (38,I) | Common DATCOM | Noise signal (dBm) |
| EPSLNT | Common GEOMRT | Elevation angle (rad) of target with respect to radar | ALLINF (39,I) | Common DATCOM | Target body signal (dBm) |
| GNINTS | Common OPTPRF | Array of integration gains for each PRF (absolute) | ALLINF (40,I) | Common DATCOM | Computed $P_d$ |
| GRANGT | Common GEOMRT | Ground range from radar to target (m) | ALLINF (41,I) | Common DATCOM | Doppler circular scan rate (Hz) |
| HEDDEG | Common TARDAT | Heading angle of the target measured from true north at the target flight path point (deg) | AZDOUT | Common OUTCOM | Flight path mode - Target azimuth (deg) |
| IAGCLN | Common PLTCOM | Target altitude flag:<br>1 = m above ground level<br>0 = m above MSL | CLTOUT | Common OUTCOM | Flight path mode - Clutter signal (dBm) |
| ISBLOC | Common DBLOCK | Indicates whether or not the data block was supplied and if the data was complete | ELDOUT | Common OUTCOM | Flight path mode - Target elevation (deg) |
| JAMTYP | Common JAMCOM | Jammer type indicator:<br>1. On-board deception jammer<br>2. Standoff noise jammer<br>3. Self screening noise jammer<br>4. On-board deception and standoff noise jamming<br>5. Self-screening and standoff noise jamming | **MSKOUT** | Common OUTALP | Flight path mode - Array of masking and detection status indicators |
| MASKED | Common LOGICL | Indicates whether the target is masked | RCSOUT | Common OUTCOM | Flight path mode - Aircraft radar cross section ($m^2$) |
| NPRFS | Common RADPAR | Number of pulse repetition frequencies | RNGOUT | Common OUTCOM | Flight path mode - Target range (km) |
| NTPTS | Common TARDAT | Number of target flight path points | SIGTOI | Common PLTCOM | Results for point (I,J) in contour plot mode |
| NUMXY | Common PLTCOM | Number of points in each row and column of contour plot matrix | **SIGTOI (I,J,1)** | Common PLTCOM | Contour plot mode - Presumed S/I (dB) |
| PI | Common CONSTR | π | SIGTOI (l,J,2) | Common PLTCOM | Contour plot mode - Terrain height (m above MSL) |
| RANGET | Common GEOMRT | Range from radar to target (m) | SIGTOI (I,J,3) | Common PLTCOM | Contour plot mode - Computed $P_d$ |
| REARTH | Common ENVIRO | Radius of the earth modified to account for refractivity (m) | SOBJDB | Common OUTCOM | Flight path mode - On-board jammer signal (dBm) associated with the pulse repetition frequency |

Table 2.22-5 Subroutine PULDOP Inputs and Outputs

| SUBROUTINE: PULDOP | | | | | |
|---|---|---|---|---|---|
| INPUTS | | | OUTPUTS | | |
| **NAME** | **TYPE** | **DESCRIPTION** | **NAME** | **TYPE** | **DESCRIPTION** |
| REZERO | Common CONSTR | Radius of the earth at mean sea level (m) | SSOJDB | Common OUTCOM | Flight path mode - Standoff jammer signal (dBm) |
| RNGPLT | Common PLTCOM | Maximum one-sided plot range (m) | STIOUT | Common OUTCOM | Flight path mode- Presumed S/I (dB) |
| RTARG | Common TARDAT | Distance from the center of the earth to the target (m) | TAROUT | Common OUTCOM | Flight path mode - Target signal (dBm) |
| SIGMAT | Common GEOMRT | Target radar cross section ($m^2$) | | | |
| SIPHIS | Common SITCOM | Sine of radar site latitude | | | |
| SITLAM | Common SITCOM | Longitude of the radar site (rad) | | | |
| TARGLA | Common TARDAT | Latitude of the target flight path point (rad) | | | |
| TARGLO | Common TARDAT | Longitude of the target flight path point (rad) | | | |
| TWOPI | Common CONSTR | $2\pi$ | | | |
| VTARIN | Common TARDAT | Target velocity for flight path mode (m/sec) | | | |
| VTPLOT | Common PLTCOM | Target velocity for contour plot mode (m/sec) | | | |
| XYSTRT | Common PLTCOM | First value of x and y in contour plot matrix | | | |
| ZTPLOT | Common PLTCOM | Target height (m) | | | |

Table 2.22-6 Subroutine PULSED Inputs and Outputs

| SUBROUTINE: PULSED | | | | | |
|---|---|---|---|---|---|
| INPUTS | | | OUTPUTS | | |
| **NAME** | **TYPE** | **DESCRIPTION** | **NAME** | **TYPE** | **DESCRIPTION** |
| AMTIMN | Common RADPAR | Array of minimum angles for each MTI gate | ALLINF | Common DATCOM | Array of results for each point I in flight path mode |
| AMTIMX | Common RADPAR | Array of maximum angles for each MTI gate | ALLINF (16,I) | Common DATCOM | Noise signal (dBm) |
| ATTDEG | Common TARDAT | Attitude (climb) angle of the target flight path point (deg) | ALLINF (18,I) | Common DATCOM | Target rotor signal (dBm) |
| BNKDEG | Common TARDAT | Bank (roll) angle of the target at the target flight path point (deg) | ALLINF (19,I) | Common DATCOM | Interference signal (dBm) |

Table 2.22-6 Subroutine PULSED Inputs and Outputs

| **SUBROUTINE: PULSED** | | | | | |
|---|---|---|---|---|---|
| **INPUTS** | | | **OUTPUTS** | | |
| **NAME** | **TYPE** | **DESCRIPTION** | **NAME** | **TYPE** | **DESCRIPTION** |
| **CONTOR** | Common RADPAR | One-pulse S/I required for target detection; i.e, threshold (dB) | ALLINF (20,I) | Common DATCOM | True target signal (dBm) |
| COPHIS | Common SITLAM | Cosine of radar site latitude | ALLINF (21,I) | Common DATCOM | False target signal (dBm) |
| DBJTOS | Common JAMCOM | J/S ratio necessary for the jammer to be effective (dB) | ALLINF (35,I) | Common DATCOM | Ground range (km) |
| DEGRAD | Common CONSTR | Factor to change degrees to radians | ALLINF (36,I) | Common DATCOM | Detection threshold (dB) |
| DOPCSR | Common GEOMRT | Sum of the conical scan rate and doppler frequency shift of the target (Hz) | ALLINF (37,I) | Common DATCOM | Integration gain (dB) |
| DXYPLT | Common PLTCOM | X and Y increment in contour plot | ALLINF (39,I) | Common DATCOM | Target body signal (dBm) |
| EPSLNR | Common GEOMRT | Radar antenna elevation angle (rad) | ALLINF (40,I) | Common DATCOM | Computed $P_d$ |
| EPSLNT | Common GEOMRT | Elevation angle (rad) of target with respect to radar | ALLINF (41,I) | Common DATCOM | Doppler circular scan rate (Hz) |
| GANINT | Common RADPAR | Integration gain for a pulse radar (absolute) | AZDOUT | Common OUTCOM | Flight path mode - Target azimuth (deg) |
| GRANGT | Common\| GEOMRT | Ground range from radar to target (m) | CLTOUT | Common OUTCOM | Flight path mode - Clutter signal (dBm) |
| HEDDEG | Common TARDAT | Heading angle of the target measured from true north at the target flight path point (deg) | ELDOUT | Common OUTCOM | Flight path mode - Target elevation (deg) |
| IAGCLN | Common PLTCOM | Target altitude flag<br>1 = m above ground level<br>0 = m above MSL | **MSKOUT** | Common OUTALP | Flight path mode - Array of masking and detection status indicators |
| ISBLOC | Common DBLOCK | Indicates whether or not the data block was supplied and if the data was complete | RCSOUT | Common OUTCOM | Flight path mode - Aircraft radar cross section ($m^2$) |
| JAMTYP | Common JAMCOM | Jammer type indicator:<br>1. On-board deception jammer<br>2. Standoff noise jammer<br>3. Self-screening noise jammer<br>4. On-board deception and standoff noise jamming<br>5. Self-screening and standoff noise jamming | RNGOUT | Common OUTCOM | Flight path mode - Target range (km) |
| MASKED | Common LOGICL | Indicates whether the target is masked | SIGTOI | Common PLTCOM | Results for point (I,J) in contour plot mode |
| NGATE | Common RADPAR | Number of MTI gates | **SIGTOI (I,J,1)** | Common PLTCOM | Contour plot mode - Presumed S/I (dB) |
| NTPTS | Common TARDAT | Number of target flight path points. | SIGTOI (I,J,2) | Common PLTCOM | Contour plot mode - Terrain height (m above MSL) |

Table 2.22-6 Subroutine PULSED Inputs and Outputs

| SUBROUTINE: PULSED | | | | | |
|---|---|---|---|---|---|
| INPUTS | | | OUTPUTS | | |
| NAME | TYPE | DESCRIPTION | NAME | TYPE | DESCRIPTION |
| NUMXY | Common PLTCOM | Number of points in each row and column of contour plot matrix | SIGTOI (I,J,3) | Common PLTCOM | Contour plot mode - Computed $P_d$ |
| PI | Common CONSTR | $\pi$ | SOBJDB | Common OUTCOM | Flight path mode - On-board jammer signal (dBm) associated with the pulse repetition frequency |
| RANGET | Common GEOMRT | Range from radar to target (m) | SSOJDB | Common OUTCOM | Flight path mode - Standoff jammer signal (dBm) |
| REARTH | Common ENVIRO | Radius of the earth modified to account for refractivity (m) | STIOUT | Common OUTCOM | Flight path mode - Presumed S/I (dB) |
| REZERO | Common CONSTR | Radius of the earth at mean sea level (m) | TAROUT | Common OUTCOM | Flight path mode - Target signal (dBm) |
| RMTIMN | Common RADPAR | Array of minimum ranges for each MTI gate (m) | | | |
| RMTIMX | Common RADPAR | Array of maximum ranges for each MTI gate (m) | | | |
| RNGPLT | Common PLTCOM | Maximum one-sided plot range (m) | | | |
| RTARG | Common TARDAT | Distance from the center of the earth to the target (m) | | | |
| SIGMA3 | Common RADPAR | $3\sigma_c$ where $\sigma_c$ is rms clutter frequency spread | | | |
| SIGMAT | Common GEOMRT | Target radar cross section ($m^2$) | | | |
| SIPHIS | Common SITCOM | Sine of radar site latitude | | | |
| SITLAM | Common SITCOM | Longitude of the radar site (rad) | | | |
| TARGLA | Common TARDAT | Latitude of the target flight path point (rad) | | | |
| TARGLO | Common TARDAT | Longitude of the target flight path point (rad) | | | |
| TWOPI | Common CONSTR | $2\pi$ | | | |
| VTARIN | Common TARDAT | Target velocity in flight path mode (m/sec) | | | |
| VTPLOT | Common PLTCOM | Target velocity in contour plot mode (m/sec) | | | |
| XYSTRT | Common PLTCOM | First value of x and of y in contour plot matrix | | | |
| ZTPLOT | Common PLTCOM | Target height (m) | | | |

Table 2.22-7 Subroutine RDRINT Inputs and Outputs

| SUBROUTINE: RDRINT | | | | | |
|---|---|---|---|---|---|
| **INPUTS** | | | **OUTPUTS** | | |
| **NAME** | **TYPE** | **DESCRIPTION** | **NAME** | **TYPE** | **DESCRIPTION** |
| ASIDDB | Common RADPAR | Mainlobe-to-peak sidelobe difference of the Chebychev filters (dB) | AVGMTI | Common RADPAR | Average power gain of the MTI system |
| AZMAXD | Common RADPAR | Maximum azimuth pointing angle of the radar antenna (degrees) | AZMAXR | Common RADPAR | Maximum azimuth pointing angle of the radar antenna (radians) |
| AZMIND | Common RADPAR | Minimum azimuth pointing angle of the radar antenna (degrees) | AZMINR | Common RADPAR | Minimum azimuth pointing angle of the radar antenna (radians) |
| AZOCLD | Common RADPAR | Maximum off-boresight angle in azimuth for which clutter returns will be computed (deg) | CONST1 | Common RADPAR | Constant used in MTI calculations |
| BWMHZ | Common RADPAR | Radar receiver intermediate frequency bandwidth for a pulsed radar (MHz) | CONST2 | Common RADPAR | Constant used in MTI calculations |
| **CHINDR** | Common RDRPD | Number of degrees of freedom for a chi-square or Weinstock target model. Used for setting the detection threshold of the radar receiver. | CONST3 | Common RADPAR | Constant used in multipath calculations |
| **CORELR** | Common RDRPD | Number of correlated blocks for a chi-square target model. Used for setting the detection threshold of the radar receiver. | CONST4 | Common RADPAR | Constant used in multipath calculations |
| DAZCLD | Common RADPAR | Azimuth angle increment used in computing clutter returns (degrees) | **CONTOR** | Common RADPAR | Detection threshold (dB) |
| DEGRAD | Common CONSTR | Conversion factor, degrees to radians | CTAUO2 | Common RADPAR | One-half the speed of light times compressed pulse width |
| ELMAXD | Common RADPAR | Maximum elevation pointing angle of the radar antenna (degrees) | CTAUO4 | Common RADPAR | One-fourth the speed of light times compressed pulse width |
| ELMIND | Common RADPAR | Minimum elevation pointing angle of the radar antenna (degrees) | DAZCLR | Common RADPAR | Azimuth angle increment used in computing clutter returns (radians) |
| FILTBW | Common RADPAR | Radar filter bandwidth (Hz) | ELMAXR | Common RADPAR | Maximum elevation pointing angle of the radar antenna (radians) |
| FMTIDB | Common RADPAR | Minimum power response of the MTI, floor value of the MTI response (dB) | ELMINR | Common RADPAR | Minimum elevation pointing angle of the radar antenna (radians) |

Table 2.22-7 Subroutine RDRINT Inputs and Outputs

| SUBROUTINE: RDRINT | | | | | |
|---|---|---|---|---|---|
| INPUTS | | | OUTPUTS | | |
| NAME | TYPE | DESCRIPTION | NAME | TYPE | DESCRIPTION |
| FPICUB | Common CONSTR | $(4\pi)^3$ | ESQUAR | Common RADPAR | Constant used in Chebychev filter |
| FREQIN | Common RADPAR | Frequency of the radar (MHz) | FCFREQ | Common RADPAR | Center frequency of Chebychev filter. Initialized to 0.0 Hz. |
| **IFLMOD** | Common RDRPD | Target fluctuation model used to determine the detection threshold of the radar receiver | FILTBW | Common RADPAR | Radar filter bandwidth (Hz) |
| IRADAR | Common RADPAR | Radar type<br>1 = pulsed (MTI)<br>2 = pulse doppler | FRQFAC | Common RADPAR | Frequency factor used in calculating atmospheric attenuation |
| **ISQLAW** | Common RADPAR | Radar detector type<br>0 = square-law<br>1 = linear envelope | GANOIS | Common RADPAR | Noise bandwidth of the doppler filter |
| NDELAY | Common RADPAR | Number of delays in the MTI | GMNMTI | Common RADPAR | Minimum power response of the MTI system |
| NFILTR | Common RADPAR | Number of doppler filters in the bank | IFREQ | Common RADPAR | Frequency factor used in calculating atmospheric attenuation |
| NPRFS | Common RADPAR | Number of pulse repetition frequencies | NAZCLT | Common RADPAR | Number of azimuths used in clutter calculations |
| **NPULSE** | Common RADPAR | Number of pulses integrated | **NPULSS** | Common OPTPRF | Number of pulses integrated for each PRF |
| ONETHR | Common CONSTR | 1/3 | PIOPRF | Common RADPAR | Array: $\pi/f_i$ for each PRF $f_i$ |
| PCR | Common RADPAR | Pulse compression ratio | RAMBGS | Common OPTPRF | Ambiguous range of radar (m) |
| PI | Common CONSTR | $\pi$ | RLAMDA | Common RADPAR | Radar wavelength (m) |
| PRFHZ | Common RADPAR | Radar pulse repetition frequency (Hz) | RUNAMB | Common RADPAR | Unambiguous range of radar (m) |
| **PSUBD** | Common RADPAR | Probability of detection | SIGMA3 | Common RADPAR | $3\sigma_s$ where $\sigma_s$ is RMS clutter frequency spread |
| **PSUBFA** | Common RADPAR | Probability of false alarm | STPFRQ | Common RADPAR | Constant used in Chebychev filter calculations |
| PSUBT | Common RADPAR | Peak power of the radar (kW) | STPFRS | Common OPTPRF | Constant used in Chebychev filter calculations |
| PULWID | Common RADPAR | Radar pulse width ($\mu$sec) | TARCON | Common RADPAR | Constant used in the radar range equation. Includes power, gain, loss, wave length, $\pi$, and PCR factors. |
| RGANDB | Common RGAINS | Boresight receive gain (dB) | TIMINT | Common RADPAR | Radar integration time (sec) |
| **SIGDBR** | Common RDRPD | Sigma parameter of a log normal distribution | | | |

Table 2.22-7 Subroutine RDRINT Inputs and Outputs

| SUBROUTINE: RDRINT | | | | | |
|---|---|---|---|---|---|
| INPUTS | | | OUTPUTS | | |
| NAME | TYPE | DESCRIPTION | NAME | TYPE | DESCRIPTION |
| SIGMAC | Common RADPAR | Standard deviation of the Gaussian portion of the clutter power spectral density. | | | |
| SLOSDB | Common RADPAR | System losses (dB) | | | |
| TGANDB | Common TGAINS | Boresight transmit gain (dB) | | | |
| **THOLDB** | Common RDRPD | User-defined detection threshold (dB) for the radar receiver | | | |
| TLOSDB | Common RADPAR | Radar transmission loss (dB) | | | |
| VLIGHT | Common CONSTR | Velocity of light (m/sec) | | | |

Table 2.22-8 Subroutine THRESH Inputs and Outputs

| SUBROUTINE: THRESH | | | | | |
|---|---|---|---|---|---|
| INPUTS | | | OUTPUTS | | |
| **NAME** | **TYPE** | **DESCRIPTION** | **NAME** | **TYPE** | **DESCRIPTION** |
| **ISQLAW** | Argument | 0 =Linear detector<br>1 =Square-law detector | **CONTOR** | Argument | The one-pulse signal-to-noise ratio (dB) required for target detection |
| **ITYPE** | Argument | Fluctuation type indicator<br>0 =Non-fluctuating<br>1 =Swerling 1<br>2 =Swerling 2<br>3 =Swerling 3<br>4 =Swerling 4<br>5 =Chi-square<br>6 =Weinstock<br>7 =Log-normal | DBGAIN | Argument | The integration gain (dB) for NPULSE pulses integrated |
| **NPULSE** | Argument | Number of pulses integrated | | | |
| **PSUBFA** | Argument | Probability of false alarm | | | |
| **PSUBD** | Argument | Probability of detection | | | |
| **CHNDF** | Argument | Number of degrees of freedom for chi-square or Weinstock distribution | | | |
| **CORLB** | Argument | Number of blocks correlated for chi-square distribution | | | |
| **SIGDB** | Argument | Sigma parameter of log-normal distribution | | | |

Unlike the subroutine I/O tables, the tables for BINPRO give inputs and outputs for the entire program, not just the main routine, also called BINPRO. There are two types of output from BINPRO, the file of data to be plotted (table 2.22-9) and a file of auxiliary data to define plotting parameters (table 2.22-8).

Table 2.22-9 Program BINPRO Inputs and Auxiliary Outputs

| PROGRAM: BINPRO | | | | | |
|---|---|---|---|---|---|
| INPUTS | | | AUXILIARY OUTPUTS | | |
| **NAME** | **TYPE** | **DESCRIPTION** | **NAME** | **MODE** | **DESCRIPTION** |
| ASCFIL | Command Line | Name for ASCII file to be output | DXYPLT | All | X and Y increment for plot (m) |
| **CONTOR** | Binary File | Detection threshold value (dB) | HGTUNT | All | Terrain height units |

Table 2.22-9 Program BINPRO Inputs and Auxiliary Outputs

| PROGRAM: BINPRO | | | | | |
|---|---|---|---|---|---|
| INPUTS | | | AUXILIARY OUTPUTS | | |
| **NAME** | **TYPE** | **DESCRIPTION** | **NAME** | **MODE** | **DESCRIPTION** |
| DXYPLT | Binary File | X and Y increment for plot (m) | MAXRNG * RNGFAC | Contour plot | Maximum detection range (m) of contour |
| HGTUNT | Command Line | Terrain height units | MODE | All | Post-processing mode |
| IAGLCN | Binary File | 1 = target altitude is AGL<br>0 = target altitude is MSL | NUMXY | All | Number of points in each row and column of the contour plot matrix |
| MODE | Command Line | Post-processing mode | OUTFIL | All | Name of the plot output file |
| NUMXY | Binary File | Number of points in each row and column of the contour plot matrix | PSUBD | Contour ($P_d$) mode | Input minimum probability o detection required for detection |
| PDVALS | Binary File | Probability of detection at (I,J) contour point | RNGPLT * RNGFAC | All | Maximum one-sided range of the plot (m) |
| PFINAM | Command Line | Name of binary file to be processed | RNGUNT | All | Range units |
| PLTLAB | Binary File | Plot label | SFACDB | All except Contour ($P_d$) | Scale factor |
| PSUBD | Command Line | Minimum probability of detection required for detection | STIUNT | All | S/I or $P_d$ units |
| RNGPLT | Binary File | Maximum one-sided plot range (m) | VTPLOT | All | Target speed (m/sec) |
| RNGUNT | Command Line | Range units | ZTPLOT | All | Target altitude (m) |
| SFACDB | Command Line | Scale factor (dB) for modifying S/I values before processing (used only if SFDSW ≠ PD and ODE ≠ TERR | | | |
| SFPDSW | Command Line | Scale factor / $P_d$ switch | | | |
| SIGTOI | Binary File | S/I at the (I,J) contour point (dB) | | | |
| STIUNT | Command Line | S/I or $P_d$ units | | | |
| TERRHT | Binary File | MSL height of terrain at the (I,J) contour point (m) | | | |
| VTPLOT | Binary File | Target speed (m/sec) | | | |
| ZTPLOT | Binary File | Target altitude (m) | | | |

Table 2.22-10 Program BINPRO Plot File Outputs

| MODE | VARIABLE NAMES | DESCRIPTION |
|---|---|---|
| cont | x: CRANGE * RNGFAC<br>y: DRANGE * RNGFAC | Coordinates of points at which detection occurs |
| stoi | x: CRANGE<br>y: DRANGE<br>x: STOI or STOIDB | z = S/I (absolute or dB) at point (x,y) |
| pdet | x: CRANGE<br>y: DRANGE<br>z: PDET or PDETDB | z = $P_d$ (absolute or dB) at point (x,y) |
| terr | x: CRANGE<br>y: DRANGE<br>z: TERRHT * HGTFAC | z = Terrain height (m above MSL) at point (x,y) |
| stir | x: DRANGE<br>y: STOI or STOIDB | y = S/I (absolute or dB) at the point (0,x) |
| cnt3* | x: CRANGE<br>y: DRANGE<br>z: TGTHT | x and y are coordinates of points where detection occurs.<br>z = target altitude at point (x,y) |
| * This mode is not fully implemented | | |

## 2.22.4 Assumptions and Limitations

The following assumptions and limitations apply only to the calculation of detection threshold in ALARM 3.0. If the user inputs the threshold value (instead of asking ALARM to calculate it), it is assumed to be correct.

The probabilities of detection and false alarm must lie within the following bounds: $0.1 \leq P_d \leq 0.9$ and $10^{-12} \leq P_{fa} \leq 10^{-4}$

The radar detection-envelope type must be either linear or square-law.

The equivalent number of pulses integrated is assumed to be 1 in the threshold calculation.